IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RE-ISSUE PROCEEDING for U.S. Patent No. 5,906,750	§	**EXAMINER: Chester Barry**
	§	
	§	**Group Art Unit 1724**
Serial No. 09/866,145	§	
	§	**Patent Owner's Docket**
Filed May 25, 2001	§	CV – 002 CIP RI
	§	
Title: Method for Dewatering Sludge	§	

SUPPLEMENTAL DECLARATION OF MR. RICHRD A. HAASE

My name is Mr. Richard A. Haase. I am of sound mind, capable of making this Declaration based on the facts stated herein.

1. I am the President of ClearValue, Inc. and the owner of U.S. Patent 5,906,750, as well as, the pending re-issue application 09/866,145.
2. I am aware of no: industry publication, U.S. Patent, teaching or use of the teachings within the styled patent application prior to my work in the method of dewatering sludge as presented in the styled patent application.
3. I believe that I am the original inventor of U.S. Pat. No. 5,906,750 and any reissue claims allowed via 09/866,145.
4. I am personally aware of the copying of the instant invention by others at the dewatering operation for the wastewater treatment plant of College Station, Texas. I demonstrated the instant invention and the instant invention claims to the management of the wastewater treatment plant for College Station, Texas. Post my teachings, the City of College Station, Texas placed "out to bid" alum (aluminum sulfate) and a cationic polyacrylamide for use in the dewatering of thermophilic biological sludge from a thermophilic digestion process, an ATAD Process. Since said bid, I have personally witnessed the dewatering of said thermophilic biological sludge on a centrifuge wherein said thermophilic biological sludge is first conditioned with alum from Altiva and/or Southern Ionics, a distributor for SNF Holding Company, and second conditioned with a cationic polyacrylamide from Polydyne, a division of SNF Holding Company.

5. I have reviewed and understand the styled patent application, the claims therein and the proposed claims of the re-issue application. Further, I acknowledge and understand my duty of disclosure to The United States Patent and Trademark Office of any material information relating to patentability of the styled application.

6. I should be viewed as at least someone of expert skill in the art of water chemistry, biochemistry and thermodynamics, including the dewatering of biological sludge from a thermophilic digestion process.

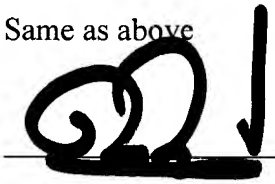
7. Every error in the patent which was corrected in the present reissue application, and is not covered by a prior oath/declaration submitted in this application, arose without any deceptive intention on the part of the applicant.

8. Attached to this Declaration is Exhibit "A", which is a true and correct copy of my original declaration submitted to The United States Patent and Trademark Office for this styled re-issue application, wherein on page 3 of 6 a correction has been made and a box marked with an "X" corresponding to "Corroborating affidavits or declaration accompany this declaration." Including this correction, the declaration attached as Exhibit "A" is true and correct to my best knowledge and belief.

9. I hereby declare that all statements made herein are of my own knowledge are true and that all statements made on information and belief are believed to be true; and further these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issued thereon.

Full Name of Declarant:	Mr. Richard A. Haase
Residence:	4402 Ringrose Drive
	Missouri City, Texas 77459
Citizenship:	USA
Mailing Address:	Same as above

Date: December 17, 2007



Signature of Declarant

Practitioner's Docket No. _____ ***PATENT***

REISSUE APPLICATION DECLARATION AND POWER OF ATTORNEY (BY INVENTOR(S) OR ASSIGNEE)

(complete A or B)

A. ☒ DECLARATION BY THE INVENTOR(S)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter that is described and claimed in letters patent number 5,906,750, granted on May 25, 1999, and for which invention I solicit a reissue patent on the invention entitled Method for dewatering sludge

the specification of which

☒ is attached hereto.

☐ was filed on _____, as reissue application number / and was amended on _____ *(if applicable).*

☒ I hereby declare that there is no assignee for this application.

NOTE: *"Where no assignee exists, applicant should affirmatively state that fact. If the file record is silent as to the existence of an assignee, it will be presumed that no assignee exists." M.P.E.P., 6th ed., rev. 1, § 1410.01.*

B. ☐ DECLARATION BY ASSIGNEE

NOTE: *The assignee of the entire interest may make the declaration, if the reissue application does not seek to enlarge the scope of the claims of the original patent. 37 C.F.R. § 1.172.*

_____, _____
(type or print name of declarant) Title

of _____,
Name of company or legal entity on whose behalf declarant is authorized to sign

declare that I am a citizen of _____ and resident of _____,

_____, that the entire title to letters patent number _____,

for _____,

granted on _____, 19____ to _____
Inventor(s)

is vested in _____
Name of company or legal entity

that I believe said named inventor(s) to be an original, first and sole inventor *(if only one name is listed)* or an original, first and part inventor *(if plural names are listed)* of the subject matter that is described and claimed in the aforesaid letters patent and in specification and for which invention I solicit a reissue patent.

EXHIBIT A

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

(37 C.F.R. § 1.175)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

☒ In compliance with this duty, there is attached an information disclosure statement in accordance with 37 C.F.R. § 1.98.

PRIORITY CLAIM

NOTE: A "claim" for the benefit of an earlier filing date in a foreign country under 35 U.S.C. 119(a)-(d) must be made in a reissue application even though such a claim was made in the application on which the original was granted. However, no additional certified copy of the foreign application is necessary. M.P.E.P., 6th ed., rev. 1, § 1417.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete C or D)

C. ☒ No such applications have been filed.

D. ☐ Such applications have been filed as follows:

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

Country	Application No.	Date of filing (day, month, year)	Date of issue (day, month, year)	Priority Claimed
				☐ YES NO ☐
				☐ YES NO ☐
				☐ YES NO ☐

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

BENEFIT OF PROVISIONAL APPLICATION

STATEMENT OF INOPERATIVENESS OR INVALIDITY OF ORIGINAL PATENT

(37 C.F.R. § 1.175)

That I believe the original patent to be

☐ partly

☒ wholly

inoperative or invalid by reason of (37 C.F.R. § 1.175(a)(1)):

(check all items that may apply)

☐ a defective specification

☐ a defective drawing

☒ the patentee claiming more or less than the patentee had a right to claim in the patent.

NOTE: At least one error must be relied upon as the basis for the reissue. 37 C.F.R. § 1.175(a)(1).

That the error listed above, which are being corrected, up to the time of the filing of this reissue declaration arose without any deceptive intention on the part of the applicant. (37 C.F.R. § 1.175(a)(2).

NOTE: For any error corrected not covered by this declaration applicant must submit, before allowance, a supplemental declaration stating that every such error arose without any deceptive intention on the part of the applicant. 37 C.F.R. § 1.175(b)(1).

☒ Corroborating affidavits or declarations of others accompany this declaration.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

THE MATTHEWS FIRM
Guy E. Matthews 24,173
William E. Johnson, Jr. 22,719
William P. Ramey, III 44,295
Robert M. Bowick, Jr. 46,569

(check the following item, if applicable)

☐ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

☒ Address

THE MATTHEWS FIRM
1900 West Loop South
Suite 1800
Houston, TX 77027

☐ Customer Number _____

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Robert M. Bowick, Jr.
(713) 355-4200

ADDED PAGE TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR REISSUE APPLICATION FOR AUTHORIZATION OF ATTORNEY(S) TO ACCEPT AND FOLLOW INSTRUCTIONS FROM REPRESENTATIVE

The undersigned to this declaration and power of attorney hereby authorize(s) the U.S. Attorney(s) named herein to accept and follow instructions from

Name(s) of authorized representative(s)

~~Richard Alan Haase~~

Address

P.O. Box 623, Sugarland, TX 77487-0623

as to any actions to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney(s) and the undersigned. In the event of a change in the person(s) from whom instructions may be taken, the U.S. attorney(s) will be so notified by the undersigned.

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

☑ BY THE INVENTOR(S)

Full name of sole or first inventor Richard Alan Haase

Inventor's signature _____

Date May 24, 2001 Country of Citizenship USA

Residence _____

Post Office Address P.O. Box 623, Sugar Land, TX 77487-0623

Full name of second joint inventor, if any _____

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

☐ BY ASSIGNEE OR PERSON AUTHORIZED TO SIGN ON BEHALF OF ASSIGNEE

NOTE: Even though inventor(s) do not sign, complete above information for inventor(s).

(complete the following, if applicable)

_____
(type name of assignee)

_____
Address of assignee

_____

_____
Title of person authorized to sign on behalf of assignee

☐ Assignment recorded in PTO on _____

Reel _____

Frame _____

☐ A separate ☐ "ASSIGNMENT (DOCUMENT) COVER SHEET" or ☐ FORM PTO 1595 is submitted herewith along with the assignment _____.

United States
Environmental Protection
Agency

Research and Development

Risk Reduction
Engineering Laboratory
Cincinnati, OH 45268

EPA/600/S2-90/037 Sept. 1990

EPA

Project Summary

Effect of Recycling Thermophilic Sludge on the Activated Sludge Process

T.B.S. Prakasam, S. Soszynski, D.R. Zenz, C. Lue-Hing, L. Blyth, and G. Sarnel

A full-scale investigation was undertaken at the Hanover Park Water Reclamation Plant (WRP) operated by the Metropolitan Water Reclamation District of Greater Chicago to study whether the net sludge production from the WRP can be reduced by implementing a scheme reported by Torpey et al. This scheme involved the recycling of sludge withdrawn from a thermophilic digester into the aeration tanks of an activated sludge system.

The Hanover Park WRP, which has a design flow capacity of 45,400 m³ per day (12 mgd), was split into a control section and an experimental section. The control and experimental sections were operated as nitrifying activated sludge systems, except that thermophilic drawoff was recycled into the aeration tanks of the experimental section from a digester system, which consisted of mesophilic and thermophilic digesters operated in series.

In contrast to the results reported by Torpey et al., a significant reduction in the net sludge production was not observed as a consequence of recycling thermophilic sludge into the aeration tanks of the Hanover Park WRP.

This Project Summary was developed by EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In 1987, the Metropolitan Water Reclamation District of Greater Chicago (herein called "the District") disposed of or used 251,000 tonnes (277,000 tons) of dry sludge solids produced at its seven sewage treatment facilities. Costs of treatment and disposal of sludge were a major fraction of total operating costs. Consequently, the District has a continuing interest in investigating processing approaches that reduce volume and mass of sludge produced in wastewater treatment.

A novel approach for reducing sludge production has been reported by Torpey and coworkers(1) and demonstrated at the Rockaway Sewage Treatment Plant in New York City. In this process, sludge from a mesophilic digester is processed through a thermophilic digester and then a portion of the thermophilic digester drawoff is recycled through the aeration tanks of an activated sludge system. The remainder of the thermophilic drawoff is passed through a rethickening and elutriation tank. The authors reported that the volume and quantity of the sludge, when compared with that produced by the activated sludge plant using mesophilic digestion with no recycle, was reduced by about 60%. The reduction in sludge quantity was attributed to additional destruction of solids achieved in the thermophilic digester and by the oxidation of some of the solids contained in the thermophilic sludge recycled to the

aeration tanks of an activated sludge system.

Torpey's findings have been supported by further work by New York City's Department of Environmental Protection. Carrio and coworkers (2) reported in 1985 that recirculation of digested sludge to the activated sludge aerators reduced total sludge production at the Newton Creek, Bowery Bay, 26th Ward, and Oakwood Beach wastewater treatment plants.

In view of the potential advantage of substantially reducing sludge production, the District undertook a demonstration at its Hanover Park WRP of Torpey's concepts; that is, in a plant using the activated sludge process, digest the sludge first by mesophilic and then by thermophilic digestion, and then divide the digested sludge into two portions, one for discharge and one for recycle to the activated sludge aeration. The Hanover Park WRP was selected for the study because it was easily divided into two nearly identical modules, which would provide a control section for comparison with the experimental section.

The following were the main objectives of the study conducted at the Hanover Park WRP:

1. To demonstrate on a full-scale whether retrofitting an existing activated sludge system with a mesophilic-thermophilic (M-T) digestion scheme and recycling the drawoff from the thermophilic digestor into the aeration tanks of an activated sludge system would reduce the volume and quantity of volatile solids produced when compared with the volume and quantity of volatile solids produced from a conventional activated sludge system using mesophilic digestion and no recycling of digested sludge.
2. To evaluate the quality of the effluents obtained under the various phases of the M-T digestion scheme and compare these with the results obtained under the conventional mode of operating an activated sludge system.
3. To determine the dewatering characteristics of the sludges resulting from the recycling of thermophilic digester drawoff and compare them with those of the drawoff derived from a conventional mesophilic digester.
4. To evaluate the odor characteristics of the sludge derived from the M-T digester sequence and compare them with those of the mesophilic digester drawoff.
5. To compare the removal of heavy metals observed in a conventional activated sludge system with the removal observed using the recycle of the sludge from the M-T digestion scheme.

Procedures

The Hanover Park WRP with a nominal dry weather capacity of 45,400 m^3 per day (12 MGD), employs primary treatment, secondary treatment by the activated sludge process, followed by sand bed filtration. The sludge is anaerobically digested, pumped to lagoon storage, and ultimately used on an adjacent farm. A schematic diagram of the plant is shown in Figure 1.

Wastewater enters the treatment plant through coarse bar screens, and flows to primary settling tanks. There are two settling tanks for each of four aeration batteries (A,B,C, and D). Two aeration tanks comprise a battery. Primary influent flows are 3,780 m^3 per day (1.0 MGD) for each aerator of Battery A, 7.57 m^3 per day (2.0 MGD) for each aerator of Battery B, and 5.68 m^3 per day (1.5 MGD) for each aerator of Batteries C and D. There is one clarifier for each of the eight aerators. Excess activated sludge is wasted to the primary tanks. After the secondary effluent from the clarifiers is chlorinated with sodium hypochlorite it then flows to rapid sand filters. Sludge is digested in four circular digesters equipped with floating covers. The digesters normally are maintained between 29 and 35°C and are continuously mixed. The digesters are 12.2 m (40 ft) in diameter with a variable depth of between 4.4 m (14.5 ft) and 5.9 m (19.5 ft). Digested sludge is pumped to storage basins and is applied to the sludge farm in the summer.

During the experimental program the plant was divided into two similar modules. Batteries A and B, the control section, were operated in the conventional activated sludge mode with mesophilic digestion of the mixed primary and waste activated sludge withdrawn from the primary tanks. The sludge was digested at 35°C in Digesters 1 and 2 operated in series. Both digesters were heated and continuously mixed.

The experimental section consisted of Batteries C and D and Digesters 3 and 4. Digester 3 received the mixed sludge from the primary tanks and was operated at 35°C. The sludge from Digester 3 was fed in series to Digester 4 where it was digested at 53°C.

The incoming wastewater flow was divided between control and experimental sections to give similar hydraulic retention times in the activated sludge aerators. After appropriate time periods to ensure steady state, increasing portions of the thermophilic sludge from the experimental section were recirculated to the aerators to study the effects on the activated sludge process and sludge production. There were five operating phases: phase 3--no re-circulation, phase 3a--10% recirculation, phase 3b--30% recirculation, phase 3c--40% recirculation, and phase 3d--50% recirculation.

Analyses were conducted by standard methods. An appropriate quality assurance program was carried out to ensure accuracy of all analytical measurements.

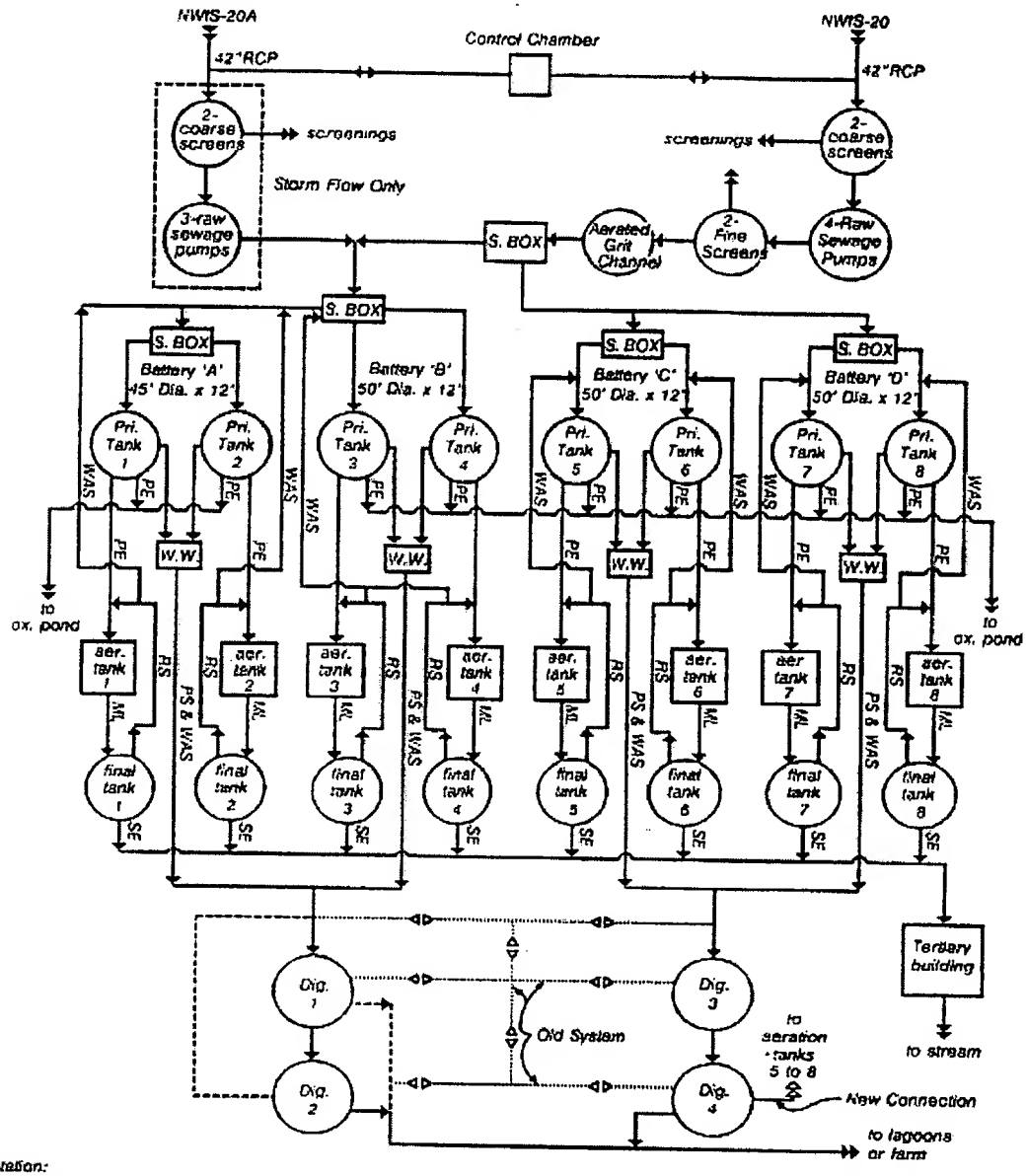
Results

The entire experimental program including modification to the plant and cleaning of digester took almost 4 yr. The program was divided into three main phases. In Phase 1, the plant was divided into the control and experimental sections, the thermophilic digester was started up, and steady state operation was achieved. In Phase 2, background data on performance of the control and experimental sections were obtained. Phase 3, the experimental phase of the program, was subdivided into Phases 3a to 3d. In these phases, recirculation of thermophilic sludge withdrawn from Digester 4 and recycled to aeration Batteries C and D was increased in steps: zero in Phase 2 to 10%, 30%, 40%, and 50% of its output.

Thermophilic Digester Operation

The thermophilic digester (Digester 4--the second digester in the experimental section) was operated successfully at 53°C. Figure 2 shows the period of startup and initial operation. Instability occurred at about 55°C. Although operation may have been possible at 55°C, temperature was reduced to 53°C to reduce system sensitivity. Except for occasional volatile acid excursions (see Figure 2), operation at 53°C was uneventful. During the data collection period that followed, volatile acids leaving Digester 4 ranged from 89 to 233 mg/L. Volatile acids from the second mesophilic digester in the control section (Digester 2) ranged from 18 to 86 mg/L.

The processing of approximately half of the sludge output of the plant through the thermophilic digester as a final digestion step created problems at the sludge farm. Numerous complaints about unpleasant odors were received from



Notation:
NWIS 20, 20A: Northwest interceptor sewers; W.W.: wet well; S. BOX: splitter box; P.S.: primary sludge; WAS: waste activated sludge; R.S.: returned sludge; ML: mixed liquor; P.E.: primary effluent; S.E.: secondary effluent; OX. POND: oxidation pond

Figure 1. Schematic of Hanover Park Water Reclamation Plant.

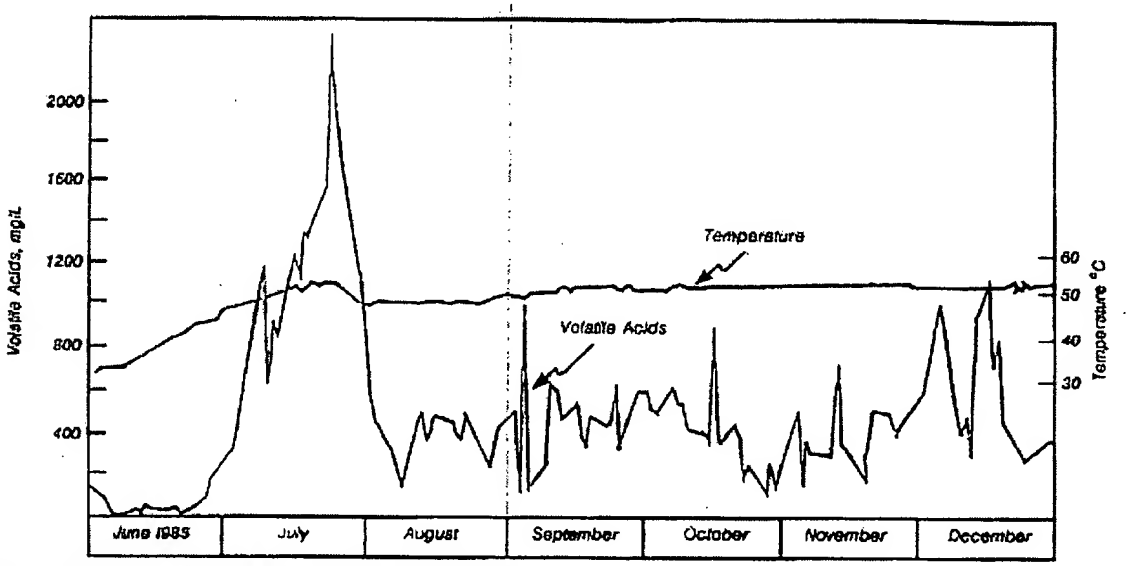


Figure 2. Volatile acids and temperature profile of digester 4.

persons living near the sludge farm during the experimental program as contrasted to practically no complaints when only mesophilically digested sludge was being discharged. The odor of thermophilically digested sludge evidently was either more offensive or more identifiable than the odor of mesophilically digested sludge.

Fate of Volatile Solids

About 2% to 5% more volatile solids were destroyed in the experimental section digesters than in the control section's mesophilic digesters when thermophilic sludge drawoff was recycled (up to 40% of the volume withdrawn) into the aeration tanks of the experimental section. When the thermophilic sludge drawoff recycle rate to the aeration tanks was increased to about 50% of the volume withdrawn, the volatile solids destruction in the experimental section digesters was found to be lower by about 12.5% than that observed in the control section digesters. At this high recirculation, the experimental section digesters were overloaded. Total residence times in control and experimental section digesters were respectively 21.5 and 8.8 days at 50% recycle. A volatile suspended solids (VSS) balance around the aerator-clarifier revealed a net VSS production for both control and experimental systems. Scatter was too great to allow a quantitative conclusion about the influence of recirculation of digested solids on VSS production.

When masses of VSS in the waste activated sludge (WAS) streams from control Battery B were compared with those from experimental Batteries C and D, recirculation of up to 40% of the meso-thermophilically digested sludge did not increase the mass of WAS per unit volume of wastewater treated.

The difference in the total digested sludge ultimately disposed from the control and experimental sections is not statistically significant. Table 1 shows the magnitude of the differences for Phase 2 and Phases 3 a-c. Recirculation of up to 30% of the thermophilic sludge produced a negligible effect on total sludge disposed per unit volume of wastewater. At 40% recirculation, the experimental section produced 13% less sludge, which was not statistically significant. At 50% recirculation (not shown in Table 1), the experimental unit produced more sludge than the control. This result is atypical because the experimental digesters were overloaded at this high recycle.

Effluent Quality and Plant Performance

The overall performance of the control and experimental sections of the Hanover Park WRP was comparable during all the phases of the study. The recycling of thermophilic sludge drawoff, even at the rate of about 50% of the volume withdrawn from the digester into the aeration tanks of the experimental section, did not have an adverse effect on the secondary effluent quality.

The overall BOD removals of the control and experimental sections were comparable and were in the range of 91.7% to 97.2% and 94.2% to 97.7%, respectively, during the various phases of the study. The corresponding secondary effluent BOD values for these sections were in the range of 3 to 9 and 3 to 6 mg/L, respectively. Recycling of up to 50% thermophilic sludge had no noticeable effect on BOD removal.

The overall suspended solids removal ranged from 83.9% to 94.2% for the control section and from 89.4% to 94.7% for the experimental section. The secondary effluent suspended solids concentration in these sections were comparable and were in the ranges of 6 to 15 mg/L (control) and 5 to 10 mg/L

Table 1. Average Volatile Solids Production Sent to Farm During the Various Experimental Phases

Phase	Sludge Production (lb/mg)*		Difference	
(Recirculation)	Control (C)	Experimental (E)	C-E	(C-E)(100) / C
2 (0%)	372	364	8	2.2%
3a(10%)	340	334	6	1.8%
3b(30%)	274	265	9	3.3%
3c(40%)	288	250	38	13.1%

* lb/mg = 0.12 = g/m³ or mg/L

(experimental). Again, recycling of digested sludge had no noticeable effect on percent removal.

The percent removal of NH_4-N was within the range of 91.0 to 98.6 percent in the control and experimental sections. That the NH_4-N concentration of the secondary effluent was less than 1.2 mg/L in both of these sections indicated that the recycling of thermophilic sludge did not have an adverse effect on nitrification.

The recycling of thermophilic sludge drawoff into the aeration tanks of the experimental section did not have a discernible influence on the sludge volume index (SVI) values of the mixed liquors. However, there was too much scatter in SVI values for any firm conclusions on the effect of recycling.

A comparison of the mixed liquor dissolved oxygen concentration and oxygen uptake rate data for the control and experimental section aeration tanks revealed no significant trends. Scatter in the results prevented drawing any firm conclusions on the effect of recycling on these variables.

The recycling of thermophilic sludge into the aeration tanks of the experimental section did not seem to alter the microbiological profile of the mixed liquor when compared with that of the mixed liquor of the control section aeration tanks.

The soluble concentration of Zn, Cd, Cu, Cr, Ni, Pb, and Hg remained approximately the same in the digester feeds and draws; this indicated that no significant solubilization of these metals occurred during mesophilic or thermophilic digestion. However, the soluble concentration of iron in the digester feed of the control and experimental sections decreased significantly as it underwent digestion in the primary digester. No further resolubilization of this metal occurred in the secondary digesters.

Dewaterability

Capillary suction time (CST) measurements at various polymer dosages indicated that mesophilic sludge required a lower polymer dosage than did the thermophilic sludge (10 vs. 22.5 kg/dry tonne) to achieve the minimum CST that was possible. The thermophilic sludge, however, exhibited a higher floc strength than did the mesophilic sludge.

Pilot scale centrifuge studies confirmed that the thermophilic sludge required a higher polymer dosage than did the mesophilic sludge. At optimum polymer dosages, those studies also indicated that the mesophilic sludge approached 100% solids capture whereas the thermophilic sludge approached a maximum of 96% solids capture. The lower solids capture with thermophilic sludge probably resulted from the higher concentration of fine particles in it than in the mesophilic sludge.

The percent cake solids achieved in pilot-scale centrifuge studies appeared to be similar at any given polymer dosage for the mesophilic and thermophilic sludges.

Discussion and Conclusions

The recirculation of meso-thermophilically digested sludge to the activated sludge aerator caused a minor reduction in sludge mass discharged at Chicago's Hanover Park WRP that was not statistically significant. There were no adverse effects on quality of treated wastewater.

Although the Torpey Process did not degrade the quality of the treated wastewater, it did not produce the desired reduction of mass of solids that must be discharged to the environment. This result contrasts sharply with results obtained at New York City plants. One possible reason for the disagreement is that the New York City plants use high rate activated sludge processes. The waste biological sludge from these plants could very well be substantially reduced in mass by continued recirculation through the anaerobic/aerobic processes in Torpey's scheme.

In Torpey's work, sludge was elutriated before disposal. This process is not used in Chicago. It also could be responsible for loss of suspended solid material that would not occur at the Hanover plant.

Recirculation of sludge at rates above 40% overloaded the experimental section's digesters at the Hanover WRP. Although treated wastewater quality was not degraded, further increases in recirculation rate would inevitably cause this effect. An existing facility should have excess digestion capacity before the Torpey Process can be adopted.

The objectionable odor of the thermophilically digested sludge caused so many complaints that use of this process as the terminal digestion step is ill-advised if sludge is to be utilized on farmland with close neighbors.

Recommendations

Based on the lack of effect on sludge mass and the increase in digestion capacity required, the Torpey process is not recommended for Chicago's conventional rate activated sludge plants. Nor is thermophilic digestion as the terminal sludge digestion process

recommended if the sludge is to be used at a site with nearby neighbors.

The full report was submitted in fulfillment of Cooperative Agreement No. CR-811925 by the Metropolitan Water Reclamation District of Greater Chicago, Chicago, IL, under the sponsorship of the U.S. Environmental Protection Agency.

Literature Cited

1. Torpey, W. N., J. Andrews, and J. V. Basilico, J. Wat. Poll. Contr. Fed., 56, 62 (1984)," Effect of Multiple Digestion on Sludge."

2. Carrio, L. A., A. R. Lopez, et al., J. Wat. Poll. Contr. Fed., 57, 116 (1985). "Sludge Reduction by In-Plant Modification: New York City's Experiences."

T.B.S. Prakasam, S. Soszynski, O. R. Zenz, C. Lue-Hing, L. Blyth, and G. Semel are with Metropolitan Water Reclamation District of Greater Chicago, Chicago, IL 60611.

J. B. Farrell is the co-author of this summary and the EPA Project Officer (see below).

The complete report, entitled "Effect of Recycling Thermophilic Sludge on the Activated Sludge Process," (Order No. PB 90-258 518/AS; Cost: $31.00 subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:
Risk Reduction Engineering Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

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